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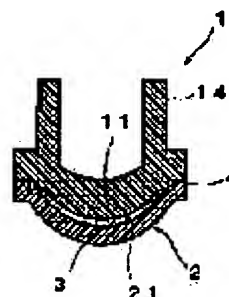
(54) MANUFACTURE OF CONTACT LENS

(57)Abstract:

PROBLEM TO BE SOLVED: To easily separate a contact lens from the male half of a mold and thereby reduce the number of production steps by manufacturing a semi-finished lens product through polymerizing a polymerizable monomer packed in a space between the male half and the female half of the mold, and cutting the semi-finished lens product sticking to the male half.

SOLUTION: A lenslike space 3 is formed in between the projecting face 11 of the male half 1 of a mold and the recessed face 21 of the female half 2 of the mold, this space 3 serving as a cavity 3 for molding a semi-finished lens product. The cavity 3 is filled with a polymerizable monomer. That is, a liquid monomer is poured into the recessed face 21 of the female half 2 in such a way that

the recessed face 21 is set facing upward. Next, both male half 1 and female half 2 are mated together by covering the female half 2 with the male half 1. In this case, the quantity of the monomer to be packed is slightly more than the volume of the cavity 3, so that the monomer overflows the space 3 to be accumulated in a liquid well part 4. Further, the polymerizable monomer packed in the space 3 is polymerized. The contact lens is formed by cutting the semi-finished lens product sticking to the male half 1 as the product is left stuck to the male half 1.



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 CLAIMS

[Claim(s)]

[Claim 1] The process which fills up the opening between these with a polymerization nature monomer combining a male and a female mold, The process which is made to carry out the polymerization of the polymerization nature monomer with which said opening was filled up, and manufactures a lens semifinished product, The process which cuts in the condition of having made the lens semifinished product which has adhered to said male, without removing or removing said female mold adhering to this male, and forms a contact lens, The manufacture approach of the contact lens characterized by having the process into which said contact lens adhering to said male and this male is made to divide in hot water.

[Claim 2] The manufacture approach of the contact lens characterized by blending a surfactant into said hot water in the manufacture approach of a contact lens according to claim 1.

[Claim 3] The manufacture approach of the contact lens characterized by said male consisting of ethylene-vinylalcohol copolymers in the manufacture approach of a contact lens according to claim 1 or 2.

[Claim 4] claims 1-3 -- the manufacture approach of the contact lens characterized by said hot water being the temperature of 80 degrees C or more in the manufacture approach of a contact lens given in either.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to the manufacture approach of the contact lens which forms with a mold the base curve side which touches a cornea about the manufacture approach of a contact lens, and forms a front curve side by cutting.

[0002]

[Description of the Prior Art] In recent years, the soft contact lens is widely used for people who were not able to wear the conventional hard lens from the goodness of the feeling of wearing, and a soft contact lens wearing person's rate is increasing.

[0003] Therefore, the technique of manufacturing a quality soft contact lens by low cost is searched for.

[0004] Conventionally, for the manufacture approach of a contact lens Both sides of the carbon button-like contact lens raw material cut down or fabricated since it was cylindrical are cut with an engine lathe. This cavity is filled up with a polymerization nature monomer using the die which has the cavity of the ball-race cutting method ground and manufactured and a lens configuration. It slushes into the mold turning around the package fabricating method for carrying out a polymerization and obtaining a contact lens, and a polymerization nature monomer, and the spin cast method for manufacturing a contact lens using a raw material spreading thinly with a centrifugal force is learned.

[0005] Although the ball-race cutting method can manufacture all kinds of contact lens, it has the problem that a manufacturing cost is high. That the package fabricating method needs various dice when manufacturing the contact lens of the many forms with which configurations differed, although a manufacturing cost is low, dimensional accuracy, and profile irregularity are greatly influenced by the precision of a mold, and there is a problem that it is difficult to manufacture an accurate contact lens. Moreover, although a manufacturing cost is low, the spin cast method needs to control many factors, such as viscosity of a polymerization nature monomer, surface tension, an amount, and a rotational frequency, and it has the problem that an applicable lens ingredient will also be limited to a specific thing while manufacture of an accurate contact lens is difficult.

[0006] Therefore, the manufacture approach called the ball-race cutting method and the middle one side mold method of the package fabricating method for manufacturing a lens semifinished product by the mold method, and manufacturing a contact lens by cutting after that in recent years is proposed.

[0007] After this one side mold method's fabricating a base curve side in a mold directly by the mold method since the base curve side which contacts directly does not need so many classes for the cornea of a contact lens in a soft contact lens, and manufacturing a lens semifinished product dozens times [several times to] the thickness of thickness required as a contact lens, the front curve side which determines frequency is formed by cutting.

[0008] Since this one side mold method can form a front curve side in the curvature of arbitration by cutting,

it it not only can set up frequency and main thickness freely, but has the description which can perform formation of the edge section easily.

[0009] The general manufacture approach of the one side mold method fabricates first the male which imprints a base curve side, and the female mold which is combined with a male and forms a cavity by an injection-molding method etc., respectively. Next, after pouring a polymerization nature monomer into a female mold, the cavity of the shape of a lens of these types of between is filled up with a polymerization nature monomer at a female mold combining a male, the polymerization of the polymerization nature monomer is carried out by heat or ultraviolet rays, and a lens semifinished product is manufactured. A lens semifinished product is cut, polish processing is carried out, a front curve side is produced [the male to which the lens semifinished product adhered where it removed the female mold or a female mold is attached as it was is attached in the engine lathe for lens cutting after polymerization termination,], and a contact lens is obtained. After washing a contact lens front face in the condition that the contact lens obtained by the male has adhered, the contact lens which performed hide rhe SHON and was swollen after that with water or a physiological saline is removed from a male by handicraft. And a physiological saline performs an extract and a permutation and a contact lens is completed.

[0010]

[Problem(s) to be Solved by the Invention] However, by the one side mold method, since it is necessary to perform cutting and polish in the condition of having made the lens semifinished product adhering to a male, a lens material and adhesive good resin are used as a material of a male so that a lens semifinished product may not exfoliate from a male in the stress applied to a lens semifinished product at the time of cutting and polish processing. Therefore, it is difficult for a contact lens to adhere to a male firmly and to separate a contact lens from a male. In the present condition, the process and hide rhe SHON process which wash the silicone oil adhering to a contact lens and abrasives are established before separation at the time of polish, after making a contact lens swell, the activity which removes a contact lens from a male by handicraft is done, there are many production processes, time and effort is taken, and there is a problem that a manufacturing cost becomes high.

[0011] This invention was made in view of the above-mentioned situation, and it aims at offering the manufacture approach of a contact lens that the number of production processes can be reduced while being able to make a contact lens separate from a male easily in the one side mold method.

[0012]

[Means for Solving the Problem] In order that this invention person may solve the above-mentioned technical problem, as a result of repeating examination wholeheartedly, a contact lens after cutting and polish in for example, the condition of having adhered to the male which consists of a lens material and an adhesive good ethylene-vinylalcohol copolymer firmly While the contact lens exfoliated from the male automatically in hot water by carrying out immersion processing into hot water 80 degrees C or more preferably, it swelled with water and this found out that unmolding and hide rhe SHON could be made to serve a double purpose.

[0013] Moreover, by the one side mold method, compared with the ball-race cutting method, dirt was a silicone oil and abrasives, and since there was little adhesion of dirt, on the occasion of hot water immersion processing, it found out that the dirt adhering to a contact lens was effectively removable by blending a surfactant with water. Therefore, it checks that washing, hide rhe SHON, and unmolding can be performed at one process by hot water immersion processing which blended the surfactant, and came to make this invention.

[0014] Therefore, the process with which invention according to claim 1 fills up a polymerization nature monomer into the opening between these combining a male and a female mold, The process which is made to carry out the polymerization of the polymerization nature monomer with which said opening was filled up, and manufactures a lens semifinished product, The process which cuts in the condition of having made the lens semifinished product which has adhered to said male, without removing or removing said female mold

adhering to this male, and forms a contact lens, The manufacture approach of the contact lens characterized by having the process into which said contact lens adhering to said male and this male is made to divide in hot water is offered.

[0015] Moreover, invention according to claim 2 offers the manufacture approach of the contact lens characterized by blending a surfactant into said hot water in the manufacture approach of a contact lens according to claim 1.

[0016] Moreover, invention according to claim 3 offers the manufacture approach of the contact lens characterized by said male consisting of ethylene-vinylalcohol copolymers in the manufacture approach of a contact lens according to claim 1 or 2.

[0017] furthermore, invention according to claim 4 -- claims 1-3 -- either is provided with the manufacture approach of the contact lens characterized by said hot water being the temperature of 80 degrees C or more in the manufacture approach of the contact lens a publication.

[0018]

[Embodiment of the Invention] Hereafter, although the gestalt of operation of this invention is explained concretely, this invention is not limited to the gestalt of the following operation.

[0019] The manufacture approach of the contact lens of this invention has the process which fills up the opening between these with a polymerization nature monomer combining a male and a female mold, as mentioned above.

[0020] One operation gestalt of a male and a female mold was shown in drawing 1 . Drawing 1 (a) shows a male 1 and (b) shows a female mold 2. A male 1 is a product made of resin, the shape of a ring dashes against the periphery side of a height 12 further with the base curve optical surface 11 which imprints the base curve of a contact lens directly, and the height 12 which consists in the periphery of a base curve optical surface, collaborates with a female mold 2, and forms a reservoir, and the field 13 is established. Moreover, the cylinder-like attachment 14 can be formed in a rear-face side, and it can attach now in the engine lathe for lens cutting by this attachment 14 after shaping.

[0021] On the other hand, it has the concave surface 21 which constitutes a cavity, it is a product made of resin, a female mold 2 is connected with the edge of the concave surface 21, and when it assembles, it is equipped with the contact surface 22 which a male 1 dashes and contacts a field 13.

[0022] A male 1 and a female mold 2 can be formed, for example with injection molding, respectively. As resin which can be used, shaping precision is good, a monomer does not receive denaturation, and it does not have a bad influence on a polymerization, but in consideration of heat-hardening, thermal resistance is good, and since it is cut with a lens ingredient, the resin which can be cut is desirable. Furthermore, since it is necessary in a male 1 to hold a lens ingredient while cutting of the lens ingredient is carried out, it is desirable that an adhesive property with a lens ingredient is good, and it is desirable that the mold-release characteristic further separated easily with a lens by hide rhe SHON by water etc. is good. From these conditions, a polyamide, an ethylene-vinylalcohol copolymer, polyacetal, polyester, polysulfone, polyolefine, etc. can be illustrated. To a male 1, an ethylene-vinylalcohol copolymer excellent in the balance of an adhesive property, a mold-release characteristic, solvent resistance, and imprint nature is desirable also in these.

[0023] The condition of having formed the die in drawing 2 combining these males 1 and female molds 2 is shown. The lens-like opening 3 is formed between the convex 11 of a male 1, and the concave surface 21 of a female mold 2, and this opening 3 serves as a cavity for fabricating a lens semifinished product. The thickness of a cavity 3 has the 2 to 20 times more desirable thing of thickness required as a contact lens for which it has about 5 to 10-time thickness especially. Moreover, the reservoir 4 is formed in the periphery of a cavity 3.

[0024] In order to fill up this cavity 3 with a polymerization nature monomer, the concave surface 21 of a female mold 2 is turned up, and a liquefied monomer is put into this concave surface 21, and as a male 1 is put on a female mold 2 and it was shown in drawing 2 after that, it combines. A little more amounts of a monomer than the capacity of an opening 3 are put in, and a monomer overflows from an opening 3 and it is

made to collect on a reservoir 4 at this time.

[0025] A polymerization nature monomer applicable to this invention is a compound which is generally used and in which a radical polymerization is possible, is the compound which contains a vinyl group, an allyl group, an acrylic radical, or an methacrylic radical in [one or more] a molecule, and is matter usually used as a hard lens or a soft contact lens ingredient. Specifically, vinyl compounds, such as acrylic ester (meta), such as alkyl (meta) acrylate, siloxanyl (meta) acrylate, fluoro alkyl (meta) acrylate, hydroxyalkyl (meta) acrylate, polyethylene-glycol (meta) acrylate, acrylic ester (meta) of polyhydric alcohol, and vinyl (meta) acrylate, a derivative of styrene, N-vinyl lactam, and carboxylic-acid (multiple valued) vinyl, fluoro alkyl (meta) acrylate, ORGANO siloxanyl (meta) acrylate, etc. are mentioned. Still more specifically For example, styrene, an acrylic acid, methyl acrylate, Ethyl acrylate, n-butyl acrylate, phenyl acrylate, 2-hydroxyethyl acrylate, 2-hydroxypropyl acrylate, A methacrylic acid, methyl methacrylate, ethyl methacrylate, n-butyl methacrylate, 2-ethylhexyl methacrylate, isobornyl methacrylate, Benzyl methacrylate, phenyl methacrylate, 2-methacryloiloxy-ethyl succinic acid, 2-hydroxyethyl methacrylate, 2-hydroxypropyl methacrylate, 2-hydroxy butyl methacrylate, fumaric acids, and those ester A methacrylonitrile, N,N-dimethylacrylamide, an N-vinyl-2-pyrrolidone, 2 and 2, 2-trifluoroethylmethacrylate, tris (trimethylsiloxy) silyl propyl methacrylate, etc. are mentioned.

[0026] Furthermore, as a cross linking agent, ethylene GURIKORUJI (meta) acrylate, Diethylene GURIKORUJI (meta) acrylate, TORIECHIRENGURIKORUJI (meta) acrylate, Propylene GURIKORUJI (meta) acrylate, TORIMECHI roll pro pantry (meta) acrylate, Pen TAERISURITORUTORI (meta) acrylate, 1, 4-butane JIORUJI (meta) acrylate, Polyfunctional monomer, such as 1, 6-hexane JIORUJI (meta) acrylate, GURISERINJI (meta) acrylate, divinylbenzene diallyl phthalate, and diethylene-glycol bisallyl carbonate, can also be used.

[0027] It is necessary to carry out by choosing the polymerization method suitable for this, the class of polymerization initiator, an addition, etc. in consideration of the property of these polymerization nature monomers to be used, i.e., viscosity, the rate of a volumetric shrinkage, a rate of polymerization, etc.

[0028] As a polymerization initiator, azobisisobutyronitril, 2, and 2'-azobis (2,4-dimethylvaleronitrile), a benzoyl peroxide, peroxidation lauryl, peroxy carbonic acid diisopropyl, etc. can be mentioned, for example. The addition of a polymerization initiator is about 0.01 - 3 % of the weight to the total amount of monomers.

[0029] Next, the manufacture approach of the contact lens of this invention carries out the polymerization of the polymerization nature monomer with which the opening 3 was filled up. A limit may not be in the polymerization method in this case, and any of photopolymerization, such as thermal polymerization or ultraviolet rays, are sufficient. Thus, a lens semifinished product thicker than the contact lens which the convex side in which a base curve side is formed in with a male 2, and forms a front curve plans can be obtained.

[0030] Next, the manufacture approach of the contact lens of this invention is cut in the condition of having made the lens semifinished product which has adhered to the male 1, without removing or removing said female mold 2 adhering to a male 1, and forms a contact lens.

[0031] After removing a female mold 2 preferably, as it fixes to the engine lathe for lens cutting using the attachment 14 of a male 1 and is shown in drawing 3, the lens semifinished product 6 is cut using a cutting tool 5, and the front curve of a contact lens is formed. It grinds using the polish liquid which suspended abrasives in the silicone oil after that, and the contact lens which has predetermined frequency is obtained. If the male 1 is formed with the ethylene-vinylalcohol copolymer, the lens semifinished product 6 can grind by stabilizing and cutting, without exfoliating from a male 1 in cutting and a polish process.

[0032] Thus, the contact lens obtained has adhered to the male 1 firmly in the dry condition, and the dirt used for polish processing, such as a silicone oil and an abrasive material, has adhered to the front face.

[0033] Next, hot water immersion down stream processing into which the male which is the description of this invention, and a contact lens are made to divide in hot water is performed.

[0034] In addition, a contact lens may be washed as pretreatment of this mold release process. For example, it can be immersed into the water solution which blended the surface activity of the non-ion system surfactant mentioned later, or an organic solvent, and a supersonic wave can be given and washed.

[0035] Hot water immersion down stream processing can perform the contact lens 7 adhering to a male 1 by being immersed into hot water W, as shown in drawing 4 . As for the water used for hot water immersion processing, it is desirable to use pure water in order to make hide rhe SHON of a contact lens serve a double purpose. And 80 degrees C or more of 90 degrees C or more of pure water are preferably heated at 95 degrees C or more. At temperature lower than 80 degrees C, a contact lens does not exfoliate from a male or exfoliation may take time amount too much. By using an autoclave, the heating temperature of 100 degrees C or more is also possible, and the upper limit of heating temperature is temperature which a male dissolves in hot water, or hydrolyzes, and does not have a bad influence on a contact lens depending on the resin which constitutes the male. Although it is usable temperature ***** [near the melting point] since the melting point is about 188 degrees C in the case of an ethylene-vinylalcohol copolymer, about 121 degrees C obtained with the autoclave of two atmospheric pressures practical are an upper limit. Usually, it is desirable to perform hot water processing all over the atmospheric-air furnace of the range whose effect which it has on an ethylene-vinylalcohol copolymer is little 97-100 degrees C. At this temperature, immersion time amount is 30-minute - 1-hour, and half extent. Moreover, in immersion processing at the temperature exceeding 100 degrees C using an autoclave, the processing time can be shortened by ending with the immersion time amount for about 1 minute, and using an autoclave.

[0036] While a contact lens 7 exfoliates automatically from a male 1 for a short time, hide rhe SHON of it is carried out by hot water immersion processing. A contact lens is swollen and the volume expands to about 1.1 to 1.3 times. It is thought that natural exfoliation is produced in distortion by this expansion.

[0037] It is desirable to blend a surfactant with the water to be used in hot water immersion processing. By performing hot water immersion processing using the water which blended the surfactant, three processes of washing of a contact lens, hide rhe SHON, and unmolding can be performed by one hot water immersion processing, and production processes can be reduced sharply. While being able to perform these three processes by short time amount by this, it is not necessary to use the dangerous organic solvent used at a washing process and, and a defect reduces a contact lens compared with the case where it exfoliates manually, from a male. Moreover, since a contact lens can be certainly exfoliated from a male, a male 1 can be fabricated using adhesive good resin, and a possibility that a lens semifinished product may exfoliate from a male at cutting and a polish process by this can be lessened further. Furthermore, in order to raise a mold-release characteristic depending on the case, a water-repellent finish given to the convex of a male 1 becomes unnecessary, and can reduce a routing counter further.

[0038] Although it is not restricted but an anionic surfactant, a cationic surfactant, and a non-ion system surfactant can be used especially as a surfactant, it is desirable to use a non-ion system surfactant in consideration of the little of effect on the safety and contact lens to the body. As a non-ion system surface active agent, for example The Pori (oxyethylene)-Pori (oxypropylene) block copolymer, Polyoxyethylene alkyl ether, polyoxyethylene alkyl phenyl ether, Polyoxyethylene alkyl ester, polyoxyethylene sorbitan alkyl ester, Polyoxyethylene hydrogenated castor oil, a fatty-acid monoglyceride, propylene glycol fatty acid ester, Fatty-acid cane-sugar ester, the Pori (oxyethylene)-Pori (oxypropylene) ethylenediamine condensate, etc. can be mentioned, it is independent in these one sort, or two or more sorts can be used together and used.

[0039] As for the loadings of a surfactant, it is desirable the range to the solubility to 0.01 % of the weight - hot water and to consider as 0.05 - 5% of range especially. By considering as this range, it is compatible in economical efficiency and sufficient detergency. Moreover, if a supersonic wave is used together, mold release can be further brought forward.

[0040] It is released from mold from a male and washing and the contact lens by which hide rhe SHON was carried out are completed as contact lenses at extract / permutation process next. This extract / permutation

process is a process which permutes the water inside a contact lens with a physiological saline, and when a contact lens is released from mold with the hot water containing the surfactant mentioned above, it also has the role which removes the surfactant of a contact lens, while extracting polymerization a non-reacted monomer from a contact lens.

[0041] An extract and a permutation can put a contact lens into a physiological saline, and can be performed on 121 degrees C and the conditions of 2 hours in an autoclave.

[0042] According to the manufacture approach of such a contact lens, by the one side mold method cut and ground while the lens semifinished product had been made to adhere to a male, damage cannot be done to a contact lens but mold release of the contact lens from the male which poses a problem can be ensured in a short time. Moreover, by blending a surfactant with the water to be used, it is possible to perform washing, hide the SHON, and three processes of mold release at one process, a routing counter can be reduced and a manufacturing cost can be reduced.

[0043]

[Example] (Example 1) The male 1 was fabricated with the ethylene-vinylalcohol copolymer, and the female mold 2 was fabricated with polypropylene. After mixing well 0.3 % of the weight (2,4-dimethylvaleronitrile) of 99 % of the weight [of 2-hydroxyethyl methacrylate], 0.4 % of the weight [of ethylene glycol dimethacrylate], 2, and 2'-azobis as a polymerization nature monomer, degassing and a nitrogen purge were repeated and this mixture was prepared.

[0044] The male 1 and the female mold 2 were assembled, as polymerization nature monomer 0.22g is taken down to a female mold 2, a male 1 is slowly taken down from right above to discharge and there and it was shown in drawing 2 . The assembled plastic pattern was supplied in the thermostat of a hot blast circuit system, and over 1 hour, a temperature up and after that, at 70 degrees C, 30-70 degrees C was heated at 100 degrees C for 2 hours, and carried out the polymerization for 2 hours. Then, the attachment 14 of the male 1 which the lens semifinished product had pasted up was attached in the engine lathe for lens cutting, and the front curve side was cut and ground with the curvature of 7.7mm. Furthermore, it cut so that the periphery convention section of a lens might become a smooth curve configuration, and the edge part was formed. Furthermore, it ground using the polish liquid which suspended abrasives in the silicone oil.

[0045] The contact lens in the dry condition of having been obtained was immersed into the water solution which dissolved new pole PE-108(Sanyo Chemical Industries, Ltd. make) 1% of the weight of the non-ion system surfactant, and heating for 90 minutes was performed at 98 degrees C all over the atmospheric-air furnace. As shown in drawing 4 , natural exfoliation of the contact lens 7 was carried out from the male 1, and it was washing needlessness.

[0046] The elution of an effluent was completed, while the these-swollen contact lens 7 is immersed in a physiological saline and carrying out water absorption of the specified quantity.

[0047] (Example 2) The male 1 was fabricated with the ethylene-vinylalcohol copolymer, and the female mold 2 was fabricated with polypropylene. After mixing well 0.5 % of the weight (2,4-dimethylvaleronitrile) of 70 % of the weight [of 2, 2, and 2-trifluoroethylmethacrylate], 10 % of the weight [of tris (trimethylsiloxy) silyl propyl methacrylate], 3.5 % of the weight [of 2-hydroxyethyl methacrylate], 1 % of the weight [of ethylene glycol dimethacrylate], 2, and 2'-azobis as a polymerization nature monomer, degassing and a nitrogen purge were repeated and this mixture was prepared.

[0048] a female mold 2 -- polymerization nature monomer 0.35g -- discharge and there -- a male 1 -- an example -- the same -- assembling -- a polymerization -- it cut and ground and the contact lens of a dry condition was obtained.

[0049] The contact lens in the dry condition of having been obtained was immersed in the 1-% of the weight water solution of new pole PE-108, and the autoclave performed heating for 1 minute at 105 degrees C. As shown in drawing 4 , natural exfoliation of the contact lens was carried out from the male 1, and it was washing needlessness.

[0050] The elution of an effluent was made to complete, while the these-swollen contact lens 7 is immersed in a physiological saline and carrying out water absorption of the specified quantity.

[0051]

[Effect of the Invention] While being able to make difficult unmolding from the plastic pattern in the one side mold method for performing cutting and polish while it had been made to adhere to a plastic pattern very easily and reliable according to the manufacture approach of the contact lens of this invention, a routing counter can be reduced and cost can be reduced.

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